Amendments to the Claims

1. (Currently amended) A control system for use with a machine having a tool arranged to move through a known path of movement, the control system characterised by comprising:

~~a means for detecting the location of objects in or adjacent the path of the tool; and~~ a light emitting means arranged to illuminate a region around the path;

a light receiving means arranged to receive light that has passed through the region such that objects in the region cast shadows on the light receiving means; and

a processing and control means in communication with the light receiving means such that the processing and control means recognises the presence of the objects in the region by images received by the light receiving means, the processing and control means being arranged to determine the distance between the objects in or adjacent the path of the tool and a leading edge of the tool, the known path extending to a stationary member;

wherein the control system includes a first mode of operation in which the processing and control means controls movement of the tool such that the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is maintained within minimum and maximum values.

2. (Canceled)

3. (Currently amended) A control system in accordance with claim [[2]] 1 characterised in that the processing and control means includes a memory means, the memory means being arranged to store images received by the light receiving means as known images.

4. (Previously presented) A control system in accordance with claim 3 characterised in that the processing and control means stores known images from an external source.

5. (Previously presented) A control system in accordance with claim 3 characterised in that the known images are assigned to portions of the memory means corresponding to a particular known machine operation.

6. (Previously presented) A control system in accordance with claim 3, wherein the machine is a press brake having an anvil as the stationary member and the tool is arranged to strike material placed on the anvil to bend the material.

7. (Original) A control system in accordance with claim 6 characterised in that the maximum value is selected such that the tool and the anvil remain in the field of view of the light receiving means and the minimum value is chosen to be a large enough value such that material can be easily placed onto or removed from the anvil.

8. (Previously presented) A control system in accordance with claim 6, characterised in that the maximum and minimum values are varied dependent on how closely the image received by the light receiving means matches a known image stored in the memory means.

9. (Previously presented) A control system in accordance with claim 6 characterised in that the control system remains in the first mode of operation while the image received by the processing and control means does not match one of the known images.

10. (Original) A control system in accordance with claim 9, characterised in that an approach switch is provided and the control system only remains in the first mode of operation while the approach switch is activated by an operator.

11. (Previously presented) A control system in accordance with claim 6 characterised in that a second mode of operation is provided, wherein when the control system is in a second mode of operation, the tool is moved toward the material to a distance closer than said minimum distance.

12. (Original) A control system in accordance with claim 11, characterised in that, in the second mode of operation, the tool is moved to a distance from the material such that an operator cannot insert fingers between the tool and the material.

13. (Previously presented) A control system in accordance with claim 11, characterised in

that the control system moves from the first mode of operation to the second mode of operation when the processing and control means recognised that a portion of the image received by the light receiving means, said portion being the shape and orientation of the material on the anvil, match with a corresponding portion of one of the known images.

14. (Previously presented) A control system in accordance with claim 11 characterised in that the control system moves from the first mode of operation to the second mode of operation when the processing and control means recognises the image received by the light receiving means as being one of said known images.

15. (Original) A control system in accordance with claim 10, characterised in that the control system only remains in the second mode of operation while the approach switch is activated by an operator.

16. (Original) A control system in accordance with claim 9, characterised in that the control system moves from the first mode of operation to the second mode of operation on release and reassertion of the approach switch by the operator and images received by the processing and control means are used to create a known image while the tool moves toward the anvil in the second mode of operation.

17. (Previously presented) A control system in accordance with claim 6, characterised in that a third mode of operation is provided, wherein when the control system is in the third mode of operation, the tool is moved to bend the material on the anvil.

18. (Original) A control system in accordance with claim 17, characterised in that the known image created in the second mode of operation is saved to the memory means as a known image after the bend is commenced.

19. (Previously presented) A control system in accordance with claim 17 characterised in that the control system moves from the second mode of operation to the third mode of operation upon release and reassertion of the approach switch.

20. (Previously presented) A control system in accordance with claim 6, characterised in that a fourth mode of operation is provided, wherein when the control system is in the fourth mode of operation, the tool is unconditionally retracted away from the anvil.

21. (Original) A control system in accordance with claim 20 characterised in that the control system is provided with a retract switch and the control system moves to the fourth mode of operation when an operator activates the retract switch.

22. (Previously presented) A control system in accordance with claim 3, characterised in that when the control system is in the first mode of operation, the processing and control means defines within the images received by the light receiving means:

a retract zone, being around the tool, such that if the nearest objects to the tool are detected in the retract zone, the tool is moved away from the objects;

a stop zone, being around the retract zone, such that if the nearest objects to the tool are detected in the stop zone, the tool movement is stopped; and

a first approach zone, being around the stop zone, such that if the nearest objects to the tool are detected in the first approach zone, the tool is moved toward the objects.

23. (Original) A control system in accordance with claim 22, characterised in that the processing and control means defines a second approach zone, being around the first approach zone, such that if the nearest objects to the tool are detected in the second approach zone, the tool is moved toward the objects at a speed relatively faster than movement of the tool occurring when the nearest objects to the tool are in the first approach zone.

24. (Previously presented) A control system in accordance with claim 3, characterised in that the tool speed is varied based on the distance between the tool and the boundary of the area defined between said minimum and maximum values to provide smooth movement of the tool.

25. (Currently amended) A control system in accordance with claim [[2]] 1 characterised in that the light emitting means includes a laser diode and the current through the laser diode is

modulated to create varying speckle patterns and thereby improve resolution of the received image.

26. (Original) A control system in accordance with claim 25, characterised in that the light receiving means includes a screen on which the light passing through the region is incident, the screen being textured to further reduce the effect of speckle patterns produced by the laser diode.

27. (Currently amended) A control system in accordance with claim [[2]] 1, characterised in that the light emitting means includes an adjustment means comprising a plurality of linear actuators, the linear actuators being connected to the light emitting means and arranged to move in a direction parallel to the axis of the emitted light such that linear movement of any one of the linear actuators changes the direction of the emitted light and movement of all of the linear actuators moves the light emitting means optically closer to or further from the light receiving means.

28. (Previously presented) A control system in accordance with claim 1, characterised in that the processing and control means comprises a software program residing on a digital signal processor.

29. (Previously presented) A control system in accordance with claim 1, wherein the minimum value is set to zero such that the tool approaches the objects when the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is greater than the maximum value but does not retract away from the objects.

30. (Currently amended) A method of controlling a machine having a tool arranged to move through a known path of movement, the known path extending to a stationary member, the method comprising:

~~detecting the location of objects in or adjacent the path of the tool;~~

illuminating a region around the path;

receiving light that has passed through the region;

recognising the presence of objects in the region by shadows cast by said objects;

determining the distance between the objects in or adjacent the path of the tool and a leading edge of the tool; and

controlling movement of the tool in a first mode of operation such that the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is maintained within minimum and maximum values.

31. (Canceled)

32. (Currently amended) A method in accordance with claim [[31]] 30 further including storing images of the received light in a memory.

33. (Previously presented) A method in accordance with claim 32 further including assigning the stored images to portions of the memory corresponding to particular known machine operations.

34. (Previously presented) A method in accordance with claim 33 wherein the machine is a press brake having an anvil as the stationary member and the tool is arranged to strike material placed on the anvil and further including:

selecting the maximum value such that the tool and the anvil remain in the field of view of the illuminated region; and

selecting the minimum value to be a large enough value such that material can be easily placed onto or removed from the anvil.

35. (Previously presented) A method in accordance with claim 34 further including varying the maximum and minimum values dependent on how closely the received images match a known images stored in the memory.

36. (Previously presented) A method in accordance with claim 34 further including controlling the movement of the tool in said first mode of operation while the received images do not match a known image.

37. (Previously presented) A method in accordance with claim 34 further including controlling the movement of the tool in said first mode of operation while an approach switch is activated by an operator.

38. (Previously presented) A method in accordance with claim 34 further including controlling movement of the tool in a second mode of operation in which the tool is moved to a distance closer than said minimum.

39. (Previously presented) A method in accordance with claim 38 further including moving the tool to a distance from the material such that an operator cannot insert fingers between the tool and the material in said second mode of operation.

40. (Previously presented) A method in accordance with claim 38 further including:

recognising that a portion of the received image, the portion being the shape and orientation of the material on the anvil, matches a corresponding portion of a known image: and

moving from the first mode of operation to the second mode of operation.

41. (Previously presented) A method in accordance with claim 38 further including:

recognising the received image as a known image; and

moving from the first mode of operation to the second mode of operation.

42. (Previously presented) A method in accordance with claim 38 further including controlling the movement of the tool in said second mode of operation while an approach switch is activated by an operator.

43. (Previously presented) A method in accordance with claim 38 further including:

recognising release and reassertion of the approach switch by the operator;

moving from the first mode of operation to the second mode of operation; and

creating a known image from the received images while the tool moves toward the anvil in the second mode of operation.

44. (Previously presented) A method in accordance with claim 34 further including operating in a third mode of operation in which the tool is moved to bend the material on the anvil.

45. (Previously presented) A method in accordance with claim 44 further including saving the known image created in the second mode of operation to the memory means as a known image after the bend is commenced.

46. (Previously presented) A method in accordance with claim 44 further including moving from the second mode of operation to the third mode of operation upon release and reassertion of the approach switch.

47. (Previously presented) A method in accordance with claim 34 further including operating in a fourth mode of operation in which the tool is unconditionally retracted away from the anvil.

48. (Previously presented) A method in accordance with claim 47 further including moving to the fourth mode of operation when an operator activates a retract switch.

49. (Previously presented) A method in accordance with claim 30 further including:

defining within the received images a retract zone around the tool such that if the nearest objects to the tool are detected in the retract zone, the tool is moved away from the objects;

defining within the received images a stop zone around the retract zone such that if the nearest objects to the tool are detected in the stop zone the tool movement is stopped; and

defining within the received images a first approach zone around the stop zone such that if the nearest objects to the tool are detected in the first approach zone, the tool is moved toward the object

50. (Previously presented) A method in accordance with claim 49 further including defining a second approach zone around the first approach zone, such that if the nearest objects to the tool are detected in the second approach zone the tool is moved toward the objects at a speed relatively faster than movement of the tool occurring when the nearest objects to the tool are in the first approach zone.

51. (Previously presented) A method in accordance with claim 50 further including varying the tool speed based on the distance between the tool and the boundary of the area defined between said minimum and maximum values to provide smooth movement of the tool.

52. (Currently amended) A method in accordance with claim [[31]] 30 further including illuminating the region with a laser diode and modulating current through the laser diode to create varying speckle patterns to improve resolution of the received images.

53. (Previously presented) A method in accordance with claim 52 further including providing a screen on which the light passing through the region is incident, the screen being textured to further reduce the effect of speckle patterns produced by the laser diode.

54. (Currently amended) A method of controlling a machine having a tool arranged to move through a known path of movement, the method comprising:

~~detecting the location of objects in or adjacent the path of the tool;~~

illuminating a region around the path;

receiving light that has passed through the region;

recognising the presence of objects in the region by shadows cast by said objects;

determining the distance between the objects in or adjacent the path of the tool and a leading edge of the tool; and

controlling movement of the tool in a first mode of operation such that the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is maintained within minimum and maximum values, wherein the maximum value is less than the maximum distance travelled by the tool through said known path of movement, the movement comprising retraction to maintain at least said minimum value.

55. (Currently amended) A method of controlling a machine having a tool arranged to move through a known path of movement, the method comprising:

~~detecting the location of objects in or adjacent the path of the tool;~~

illuminating a region around the path;

receiving light that has passed through the region;

recognising the presence of objects in the region by shadows cast by said objects;

determining the distance between the objects in or adjacent the path of the tool and a leading edge of the tool; and

controlling movement of the tool in a first mode of operation such that the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is maintained within minimum and maximum values, said minimum and maximum values being non-zero and non-equal, the movement comprising retraction to maintain at least said minimum value.

56. (Currently amended) A method of controlling a machine having a tool arranged to move through a known path of movement, the method comprising:

~~detecting the location of objects in or adjacent the path of the tool;~~

illuminating a region around the path;

receiving light that has passed through the region;

recognising the presence of objects in the region by shadows cast by said objects;

determining the distance between the objects in or adjacent the path of the tool and a leading edge of the tool; and

controlling movement of the tool in a first mode of operation such that the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is maintained within minimum and maximum values, wherein said controlling movement comprises retracting the tool to less than a fully retracted height.

57. (Previously presented) The method of claim 56 further comprising controlling movement in additional modes of operation including:

a second mode in which the tool approaches a material being worked upon; and

a third mode of operation in which the tool bends the material.

58. (Previously presented) The control system of claim 1 wherein the movement includes retraction to maintain at least the minimum value.

59. (Previously presented) The method of claim 30 wherein the movement includes retraction to maintain at least the minimum value.

60. (Previously presented) The method of claim 30 wherein the machine works on a workpiece and the objects are not said workpiece.

61. (Currently amended) A method of controlling a machine having a tool arranged to move through a known path of movement, the method comprising:

illuminating a region around the path;

receiving light that has passed through the region;

recognising the presence of objects in the region by shadows cast by said objects;

detecting the locations and extents of the objects ~~in or adjacent the path of the tool~~;

determining the distance between the objects ~~in or adjacent the path of the tool~~ and a leading edge of the tool; and

controlling movement of the tool in a first mode of operation such that the distance between the objects in or adjacent the path of the tool and the leading edge of the tool is maintained within minimum and maximum values, wherein the minimum and maximum values are altered in response to the detected extents of the objects.